Elachista nolckeni Šulcs, 1992: morphology and bionomics of immature stages (Gelechioidea: Elachistidae)

Tomasz Baran

Rzeszów University, Institute of Biology and Environmental Protection, Rejtana 16C, 35-310 Rzeszów, Poland
e-mail: tbaran@univ.rzeszow.pl

Summary. The previously unknown life history and morphology of early life stages of *Elachista nolckeni* Šulcs, 1992 are described. The last instar larva, pupa and mines of the species are illustrated for the first time. A redescription of the imago is also given. The caterpillars make *Phyllonorycter*-like mines in the leaf blades of *Phleum phleoides* (L.) Karst. Pupation takes place on the ground. The adults fly in one generation from mid-May to the beginning of July. The species inhabits open, xerothermic habitats.

Key words. Gelechioidea, Elachistidae, *Elachista nolckeni*, morphology, bionomics.

Introduction

Elachista nolckeni was described comparatively recently on the basis of specimens from Latvia, Poland and Estonia (Šulcs 1992). Except for these countries, the species has also been recorded from Austria (Šulcs, *op. cit.*), the Czech Republic (Liška 1998) and Germany (Gaedike & Heinicke 1999). In Poland it is known only from a few places located in the central and eastern parts of the country: the Zbocza Plutowskie Reserve (UTM: CE 20) (leg. T. Baran), Toruń (UTM: CD 37) (Šulcs, *op. cit.*), the Biebrzański National Park (Góra Perewida, UTM: FE 24) (Buszko 1996) and the Skarpa Dobrska Reserve (UTM: EB 68) (Buszko *et al.* 1996).

So far nothing was known about the immature stages of this elachistid moth. Three years of field research enabled the author to elaborate the food-plant and habitat preferences as well as the morphology of the preimaginal stages. Below the adults are also redescribed.

Material and methods

The study was carried out in 1998–2000. During that period 25 larvae, 12 pupae and 40 moths were examined. The material was collected in two reserves of xerothermic vegetation – the Skarpa Dobrska Reserve and the Zbocza Plutowskie Reserve. The first reserve comprises xerothermophilous plant communities growing on loess soil (Fig. 1); dominant plant species are: *Anthyllis vulneraria* L., *Artemisia campestris* L., *Brachypodium pinnatum* (L.) P.B., *Coronilla varia* L., *Festuca sulcata* (Hack.) Nym., *Helichrysum arenarium* (L.) Moench, *Inula ensifolia* L., *Juniperus communis* L., *Phleum phleoides* (L.) Karsten, *Salvia pratensis* L., and *Silene otites* (L.) Wib.

The second site is formed by sunny and dry slopes of the Wisła valley (Fig. 2); the area is rich in many species of xerothermic and steppe vegetation, such as *Adonis vernalis* L., *Anemone silvestris* L., *Brachypodium pinnatum* (L.) P.B., *Hieracium echioides* Lumnitzer, *Medicago minima* (L.) Grufb., *Salvia pratensis* L., *Stipa capillata* L. and *Stipa joannis* Cel.

Terminology of structures in male and female genitalia follows Traugott-Olsen & Nielsen (1977) and Kaila (1997, 1999), whereas the terminology relating to morphology of the larva and pupa is according to Hinton (1946), Hasenfuss (1980) and Patočka (1999). Chaetotaxy was studied after maceration of larvae in 10% KOH.

Figs. 1–2. The habitats of *Elachista nolckeni* in Poland: **1** – the Skarpa Dobrska Resrve; **2** – the Zbocza Plutowskie Reserve.

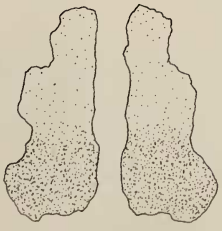
Results

Description of stages

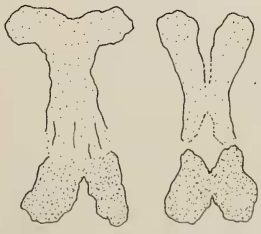
L a r v a – last instar (Figs. 3–5). Body length 5.5–6 mm (n = 20). Head yellowish brown; ocellar areas blackish. Dorsal prothoracic shield well sclerotized, especially in posterior parts; it consists of a pair of elongate plates, enlarged posteriorly, with irregular margins. Ventral prothoracic shield weakly sclerotized in median part, variable in shape, but more or less X-shaped. Anal shield sclerotized, triangular, with rounded apex. All sclerites yellowish brown, but dorsal prothoracic plates darker posteriorly. Body of the larva somewhat tapered towards the last segment (2nd and 3rd thoracic segments broadest), from pale yellowish green to olive green; prothorax more yellowish than other segments.

C h a e t o t a x y (Figs. 6–10). Thorax, T1. – On prothoracic shield, 2 pores (a, b), D1 seta and proprioreceptor MXD1. XD1 and D2 close to lateral margin of the shield (D2 ventral to XD1). SD1 ventral to XD2 and SD2, closer to the latter. L group trisetose, L1 ventral to L2 and L3. SV group unisetose. MV2 and MV3 (not proprioreceptors) almost in vertical line. V1 ventral and somewhat anterior to the leg. T2–3. – D1 somewhat dorsal to D2. SD2 dorsal to SD1. L group trisetose, L1 ventral to the others. SD2, SD1 and L1 almost in vertical line. SV group unisetose. On these segments, there are proprioreceptors: MD1, MSD1, MSD2, MV1 and MV3 (MV2 absent). Abdomen, AI.

3



4



5

Figs. 3–5. The mature larva of *Elachista nolckeni*: **3** – dorsal view of the mature larva; **4** – dorsal prothoracic shield; **5** – ventral prothoracic shield.

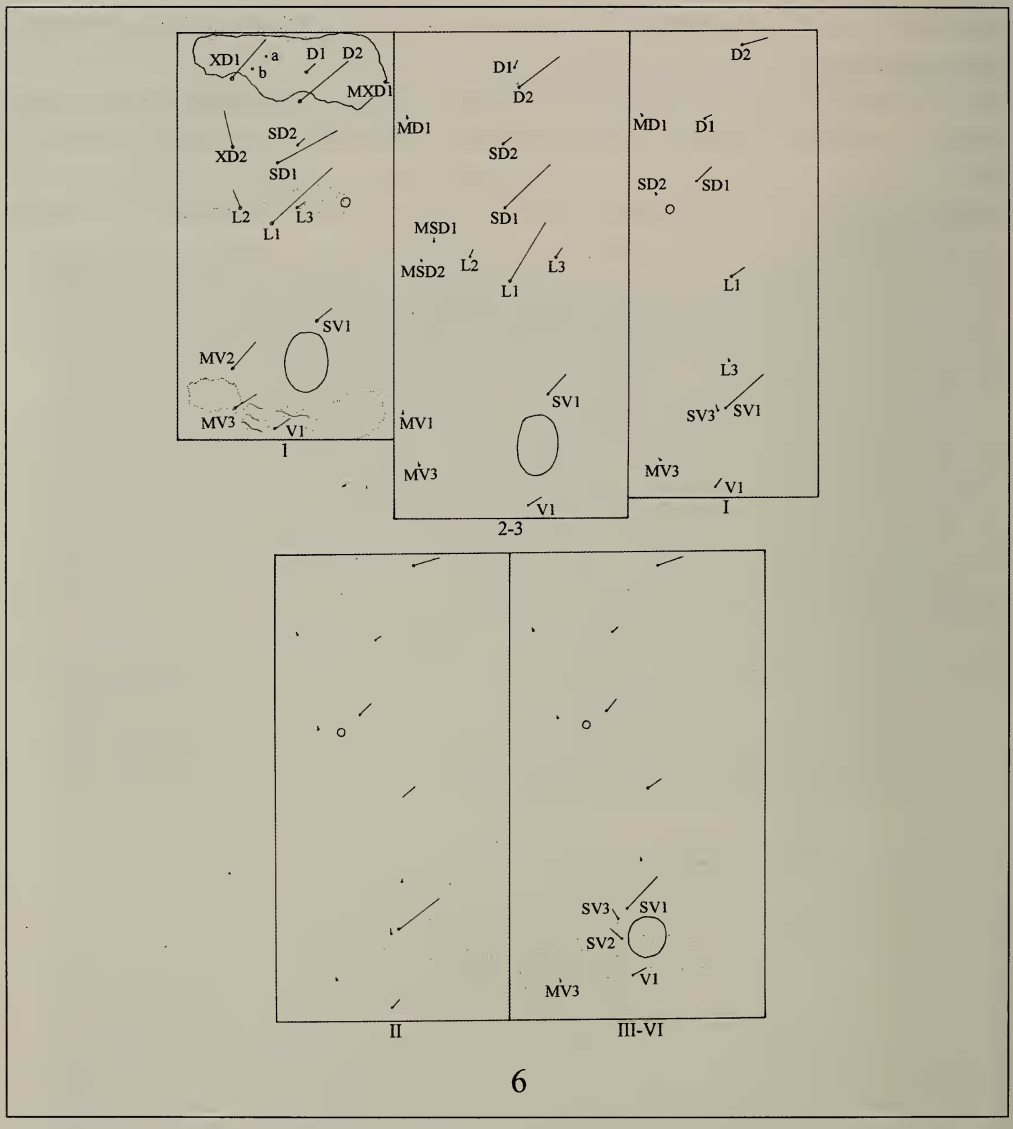
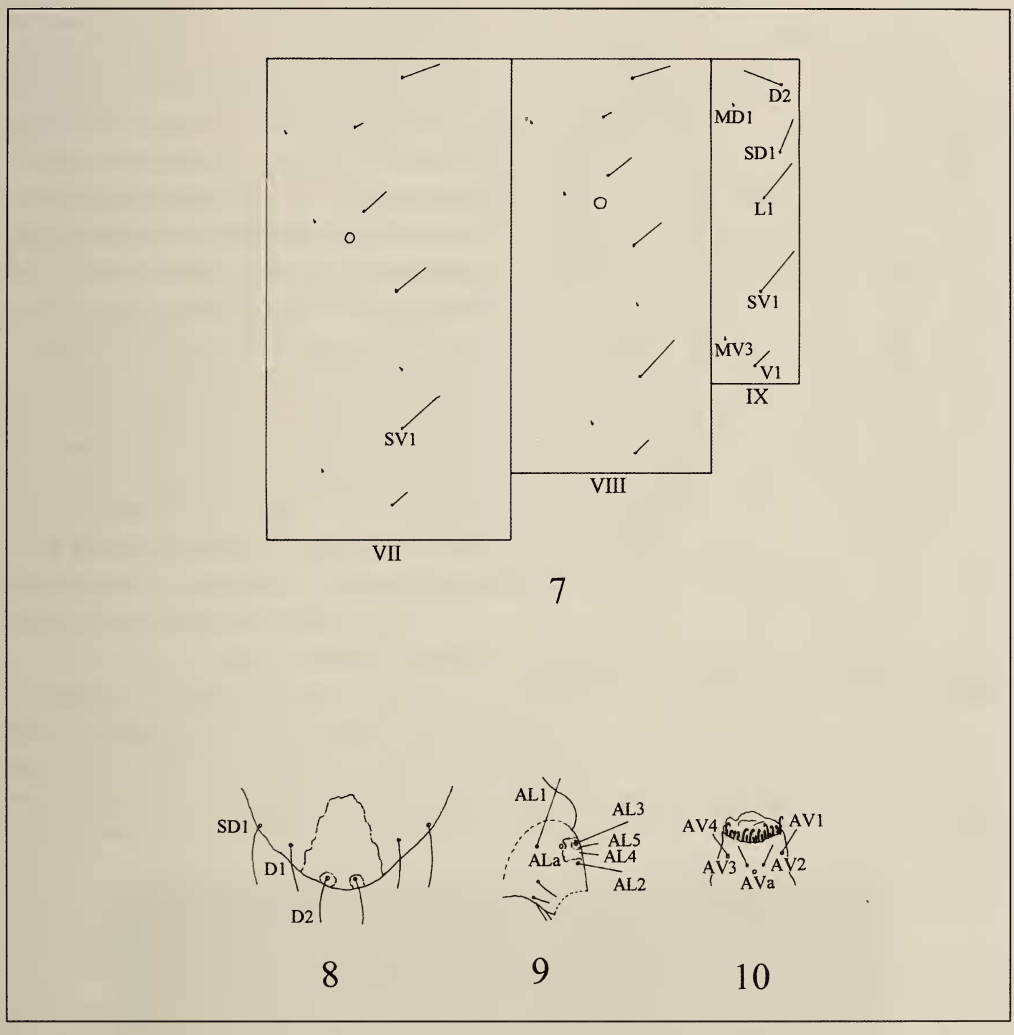


Fig. 6. Setal map (last instar): 1–3 – thoracic segments; I–VI – abdominal segments.

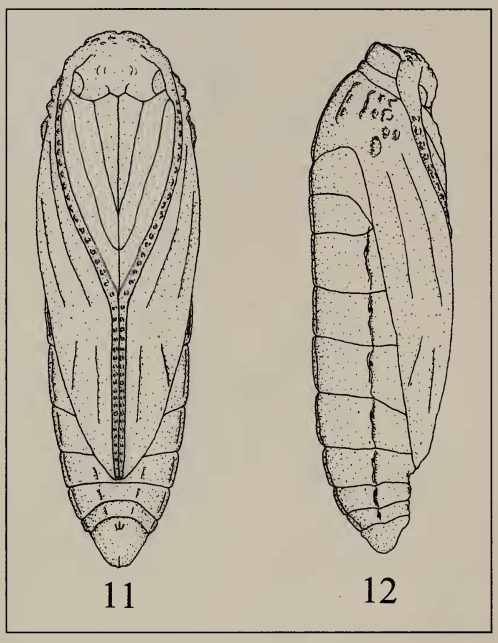
– D1 widely separated ventrally from D2. SD1 dorsal and posterior to spiracle. SD2 anterior and ventral to SD1. L group bisetose, L3 (very small seta) ventral to L1. SV group bisetose, but SV3 often absent. V1 ventral to SV setae. On the segment, proprioreceptors MD1 and MV3 occur. AII. – Arrangement of the setae similar to the previous segment, but MD1 more remote from D1, and SD1 closer to spiracle. AIII–VI. – Arrangement of MD1, D, SD and L groups as on 2nd abdominal segment. SV group trisetose, SV3 ventral and anterior to SV1, between SV1 and SV2. V1 somewhat posterior and ventral to SV2. MV3 anterior and ventral to V1. AVII. – Arrangement of MD1, D, SD and L setae similar to previous segments. SV group unisetose. V1



Figs. 7–10. Setal maps (last instar): **7** – abdominal segments VII–IX; **8** – abdominal segment X (dorsal view); **9** – abdominal segment X (lateral view); **10** – anal proleg.

ventral and slightly anterior to SV1. MV3 anterior and between SV1 and V1. AVIII. – The general arrangement of the setae similar to the 7th abdominal segment. AIX. – 5 'long' setae (D2, SD1, L1, SV1, V1) and 2 proprioreceptors (MD1, MV3). D2 and SD1 in vertical line. L1 ventral and somewhat anterior to SD1. SV1 remote ventrally from L seta. V1 ventral and slightly anterior to SV1. AX. – On the sclerotized anal plate, there is D2 only; D1 and SD1 ventral to the plate (D3 absent). AL group with 5 setae and 1 pore (ALa on line joining AL1 and AL3). AV1 and AV4 more caudally and more remote from each other than AV2 and AV3. AVa anterior to and between AV2 and AV3.

P u p a (Figs. 11–12). Length of pupa: 3.7–4.1 mm (n = 10); yellow-brown. Vertex slightly protruding over frons, with shallow incision. Labrum triangular caudally. Pro-



Figs. 11–12. The pupa of *Elachista nolckeni*: **11** – ventral view; **12** – lateral view.

boscis extended to about one third of forewing length. Antenna with protrusions, extended to apex of forewing. Mid leg extended to about a half of forewing length, and fore leg somewhat shorter. Forewing extended to posterior margin of 6th abdominal segment or ended slightly before; veins raised. Dorsal and lateral ridges prominent; the dorsal one runs from vertex to posterior margin of 8th abdominal segment, and the lateral ones run from posterior margin of 1st abdominal segment to posterior margin of 8th one. On ventral side of 6th, 7th and 8th segments there are also weak ridges. On each side of the mesonotum there is a pair of additional ridges. Lateral parts of mesonotum with raised nodules. Abdominal spiracles visible on lateral ridges.

Adult male (Fig. 13). Wingspan 9–10.5 mm (n = 15). Head and neck tuft white; labial palpus white, underside usually suffused with grey or ochreous-orange; scape of white, sometimes with ochreous-orange scales, flagellum brownish, annulated with whitish. Thorax and tegula white, often with a few ochreous-orange or black-

Fig. 13. *Elachista nolckeni*, adult male.

ish-brown tipped scales. Forewing white, strongly mottled with ochreous-orange; basal part of costa dark grey-brown; white markings consisting of slightly outward bent fascia before middle, costal and tornal spots (costal spot distinctly beyond tornal one; sometimes spots form a zigzag outer fascia), basal spot (often connected with inner fascia) and usually weakly indicated narrow terminal streak. Many blackish-brown tipped scales scattered over forewing, especially in fold between basal spot and inner fascia, between inner fascia and outer spots as well as in tornal part; scales in dorsal half between inner fascia and tornal spot bigger than others and slightly raised (groups of such scales form small dots on the wing). Cilia between tornus and apex whitish tinged ochreous with grey-brown tips; cilia on dorsum whitish. Ciliary line distinct, blackish-brown. Hindwing grey-brownish. Costal cilia coloured as hindwing, dorsal cilia whitish-orange, tinged light grey-brown mainly in basal half. Abdomen grey-brown dorsally with pale grey and whitish scales on posterior margins of segments; ventrally grey-brown, strongly covered with whitish and ochreous-white scales. Anal tuft greyish-brown from dorsal view, and whitish ventrally.

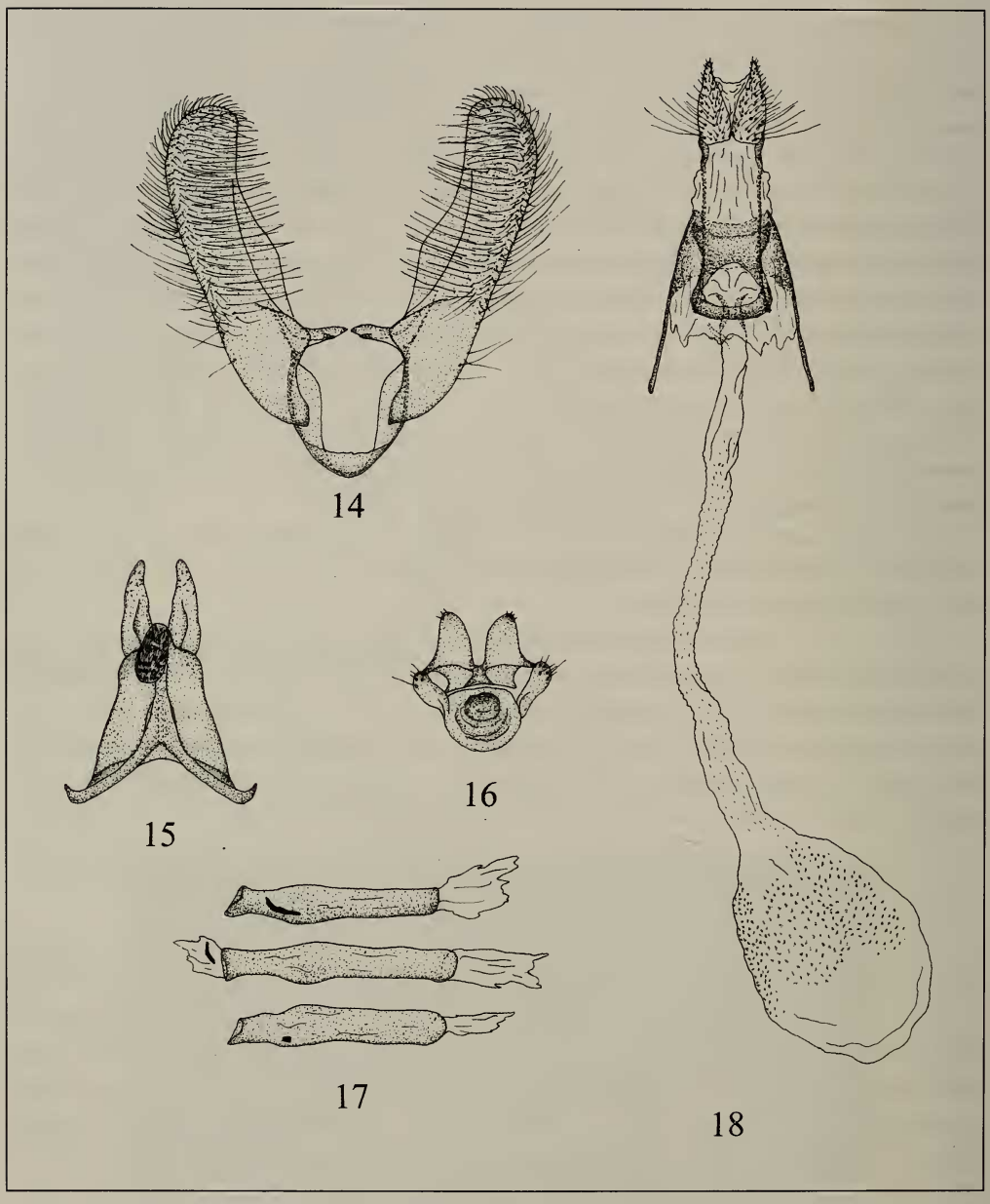
Female similar to male but usually smaller (wing span: 8–9.5 mm [n = 10]); antenna more clearly ringed; dark grey-brown suffusion at costa less distinct or invisible; anal tuft entirely whitish.

Male genitalia (Figs. 14–17). Uncus deeply indented; uncus lobes triangular, narrow and tapering, with a few minute setae distally. Gnathos elongate, rounded apically. Sacculus of valva almost straight, joining cucullus without angle. Costa convex at about the middle. Juxta lobes triangular with rounded ends and prominent lateral processes; apical parts of the lobes with a few short setae. Digitate processes tongue-shaped, short and setose apically. Median plate of juxta well sclerotized, more or less round, with a deep concavity. Vinculum without saccus, rounded. Aedeagus rather short and thick, distinctly broadened beyond the middle; distal end usually funnel-shaped; vesica with one boomerang-like or tooth-like cornutus.

Female genitalia (Fig. 18). Papillae anales of moderate length, covered with setae (the longest ones basally). Apophyses rather slender; posterior pair from 1.5 to 2 times longer than anterior one. Tergum 8 well sclerotized, anterior and posterior margins deeply concave. Sternum 8 sclerotized (more in anterior part) with more or less round ostium bursae in anterior half; lateral margins concave and anterior margin forming a semi-ring. Colliculum short as a longitudinal, lateral foldings. Ductus bursae rather long, membranous, covered with very minute spines at 3/4 of its lenght and the remaining 1/3 smooth and slightly broader than madian part. Ductus seminalis situated near to colliculum. Corpus bursae oval, with three patches of minute spines.

Life history

Eggs are laid at the basal part of a leaf of *Phleum phleoides* (L.) Karsten, in the middle or near a margin of the blade. Initially the larva mines in a narrow gallery (*Stigmella*-like), towards the leaf-tip; than it turns at or near the tip and mines downwards making a pale greenish *Phyllonorycter*-like blister, 4.5–6 mm in length (n = 12) (Fig. 19). The



Figs. 14–18. Male genitalia of *Elachista nolckeni*: **14** – complex of valvae-vinculum; **15** – complex of tegumen-uncus-gnathos; **16** – complex of juxta lobes-digitate processes-median plate; **17** – aedeagus – examples; **18** – Female genitalia of *Elachista nolckeni*.

proximal part of the blotch is rounded, irregular or divided usually into two short parts (galleries). The blister mine occupies an apical part or (rarely) a central one of the leaf. The frass is concentrated in the distal part of the mine. Because of the colour and twisted margins of the blade, the mine is relatively difficult to detect. During development (in captivity), the larvae sometimes change leaves. Pupation takes place on the

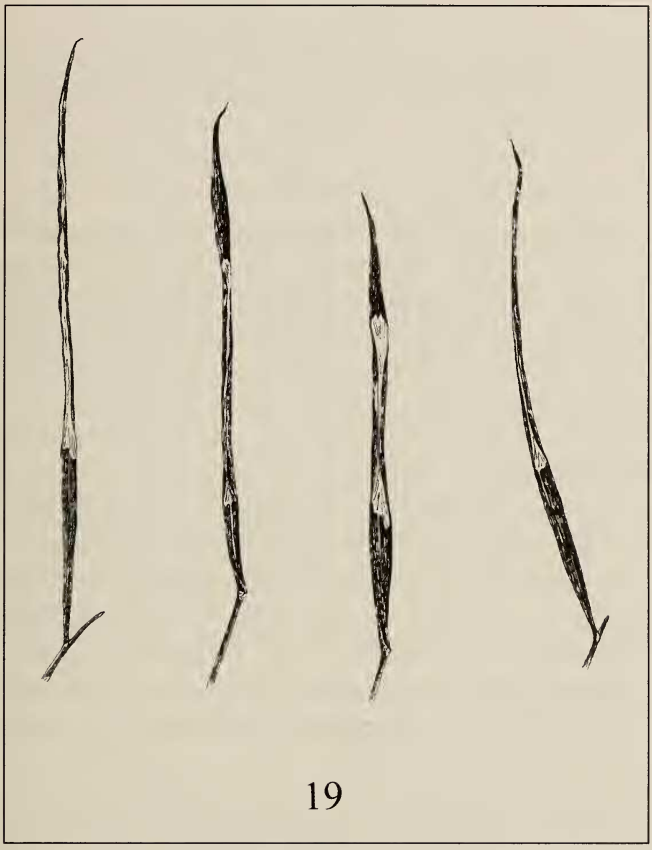


Fig. 19. Mines of the larvae of *Elachista nolckeni* on *Phleum phleoides* – examples.

ground; in the breeding containers on the bottom among leaf litter. The pupa is anchored to the substrate by a terminal segment and a silken girdle. In the laboratory, the pupal stage lasts 13–15 days. The larvae start feeding about mid-April and occur until the second half of May. Mines with mature larvae were found in large numbers in early May. Adults are univoltine and fly from the middle of May to the beginning of July, most abundantly in the first half of June. The moths may easily be found resting on leaves of various grasses or flying over plants during the day. The species occurs locally in sunny, rather open places of xerothermic grasslands. In the studied sites, *Elachista nolckeni* was observed in the same places where *Elachista subocellea* (Stephens, 1834) occurs. The latter appears usually later, but especially in June both species may fly together.

Discussion

Because little information on detailed morphology of immature stages (especially of the larvae) of Elachistidae has been published so far, it is difficult to draw general conclusions of phylogenetic importance. Nevertheless, some of the presented results

are of interest. D1 on abdominal segments 1–8 is placed distinctly ventrally to D2. This feature may be a synapomorphy for the group of species closely related with *E. nolckeni*, because the character state 'D1 more or less dorsal to D2' is a widespread condition in Elachistidae (T. Baran, unpublished) as well as in Gelechioidea and is therefore inferred to be plesiomorphic. Traugott-Olsen and Nielsen (1977) suggested that the absence of one SD seta (SD2) on abdominal segments may be a generic character defining *Elachista*. *E. nolckeni* possesses two setae from the SD group (on abdominal segment 1–8), but SD2 is apparently far away from SD1 as compared with most Gelechioidea. So, if this condition is found in other elachistid species, it may turn out to be a synapomorphy for the family. Traugott-Olsen and Nielsen (1977) also stated that *E. apicipunctella* Stainton, 1849 has no proprioreceptors. In the larva of *E. nolckeni* almost all known Ditrysian proprioreceptors were found. According to Hodges (1999) the occurrence of only one seta of the SV group on AI characterises Elachistidae s. str. However, results in the present paper reveal that SV3 on this segment may occur, although in *E. nolckeni* the seta sometimes disappears. Moreover, the position of setae from abdominal L group may have some significance in phylogeny. Here, these L setae have been designated as L1 and L3 (the seta situated more ventrally), so L2 is absent. Still, it must be stressed that the homology of L setae in Elachistidae is uncertain. Hitherto only full-grown larvae have been studied and the decision which seta really is L3 (a subprimary seta), needs research of earlier instars. According to Minet (1991), the occurrence of L1 and L2 on the same pinnaculum, or closely approximated ones, is plesiomorphic within Gelechioidea.

With respect to wing pattern and morphology of genitalia, *Elachista nolckeni* is most similar to two other central European species of Elachistidae, viz. *E. subocellea* (Stephens, 1834) and *E. collitella* (Duponchel, 1843). However, it is comparatively easily distinguished from these species even without genitalia examination; the shifting of the costal spot towards the wing apex, in relation to tornal spot, is distinctive (Fig. 13). In the male genitalia the shape of the aedeagus and juxta lobes separates males of this moth from other species. In the female genitalia the presence of three patches of spines on the corpus bursae as well as the shape of sternum 8 are diagnostic.

At the beginning of the 20th century, Toll described *Elachista subcollutella* on the basis of one specimen collected in the Ukraine (Toll 1936). This elachistid was later synonymised with *Elachista subocellea* by Traugott-Olsen & Nielsen (1977). *E. subocellea* is closely related with *E. nolckeni*. So, there was a possibility of misidentification, especially because *E. nolckeni* was described later. Since the holotype of *E. subcollutella* is probably lost (it is missing in Toll's collection preserved at the PAN, Kraków), a detailed comparison was impossible. Nevertheless, comparing the drawing of the *E. subcollutella* forewing (Toll 1936) with recent material of *E. nolckeni* and *E. subocellea* confirms the synonymy suggested by Traugott-Olsen & Nielsen (1977). *E. subcollutella* differs from *E. nolckeni* in having a transverse outer fascia. Such a fascia is typical in *E. subocellea*. Thus, there is no doubt that the elachistid described by Toll is conspecific with *E. subocellea*, while *E. nolckeni* is a good species.

Acknowledgements

I would like to thank Prof. Jarosław Buszko (Toruń, Poland) for taking the photograph of the adult. I am also sincerely grateful to Dr. L. Kaila (Helsinki, Finland) for critical comments on the manuscript, and to Prof. J. Razowski for permission to study the material of the PAN (Kraków, Poland).

References

Buszko, J. 1996. On the occurrence of *Elachista nolckeni* Šulcs (Lepidoptera, Elachistidae) in Poland. – Wiad. Ent. **15**(1): 59.

Buszko, J., J. Junnilainen, J. P. Kaitila, J. Nowacki, K. Nupponen & K. Palka 1996. New and rare to the Polish fauna species of Lepidoptera recorded in south-eastern Poland. – Wiad. Ent. **15**(2): 105–115.

Gaedike, R. & W. Heinicke (eds.) 1999. Verzeichnis der Schmetterlinge Deutschlands (Entomofauna Germanica 3). – Ent.Nachr.Ber. Dresden Beiheft 5: 1–216.

Hasenfuss, I. 1980. Die Präimaginalstadien von *Thyris fenestrella* Scopoli (Thyrididae, Lepidoptera). – Bonn. zool. Beitr. 31: 168–190.

Hinton, H. R. 1946. On the homology and nomenclature of the setae of lepidopterous larvae with some notes on the phylogeny of the Lepidoptera. – Trans.ent.Soc.Lond. 97: 1–35.

Hodges, R. W. 1999. Gelechioidea. – *In*: Kristensen, N. P. (ed.), Handbook of Zoology IV, 35. Lepidoptera, moths and butterflies 1. – W. de Gruyter, Berlin, New York. Pp. 131–158.

Kaila, L. 1997. A revision of the Nearctic species of *Elachista* s. l. II. The *argentella* group (Lepidoptera, Elachistidae). – Acta Zool.Fenn. 206: 1–93.

Kaila, L. 1999. Phylogeny and classification of the Elachistidae s. s (Lepidoptera: Gelechioidea). – Syst.Ent. **24**: 139–169.

Liška, J. 1998. Elachistidae. – *In*: Laštůvka, Z. (ed.), Checklist of Lepidoptera of the Czech and Slovak Republics (Lepidoptera). - Konvoj, Brno. p. 28–30.

Minet, J. 1991. Tentative reconstruction of the ditrysian phylogeny (Lepidoptera: Glossata). – Ent.Scand. **22**: 69–95.

Patočka, J. 1999. Die Puppen der mitteleuropäischen Elachistidae (Lepidoptera, Gelechioidea). – Bonn.zool.Beitr. **48**: 283–312.

Šulcs, I. 1992. *Elachista nolckeni* sp. n. aus Lettland (Lepidoptera, Elachistidae). – Ent.Fenn. **3**: 105–108.

Toll, S. 1936. Untersuchung der Genitalien bei *Pyrausta purpuralis* L. und *P. ostrinalis* Hb., nebst Beschreibung 11 neuer Microlepidopteren-Arten. – Annls.Mus.zool. Pol. **11**(24): 403–413, 3 pls.

Traugott-Olsen, E. & E. Schmidt Nielsen 1977. The Elachistidae of Fennoscandia and Denmark. – Fauna ent.Scand. **6**: 1–299.